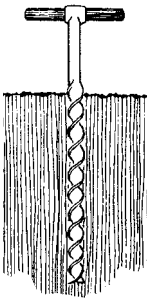


A2100

Sampling soils for testing

J.B. Peters, K.A. Kelling, and L.G. Bundy

Importance of taking good soil samples

A soil test is the only practical way of telling whether lime and fertilizer are needed. However, if a soil sample does not represent the general soil conditions of the field, the recommendations based on this sample will be useless, or worse, misleading. An acre of soil to a 6-inch depth weighs about 1,000 tons, yet less than 1 ounce of soil is used for each test in the laboratory. Therefore, it is very important that the soil sample is characteristic of the entire field. The following directions will help you collect good soil samples.

When to take soil samples

Take soil samples at any convenient time. Studies examining the effect of sampling time on soil test results suggest that test values for pH, phosphorus (P), and potassium (K) are typically slightly higher in early spring samples than in fall samples. To receive your recommendations early enough to enable you to apply the lime and fertilizer needed, it may be best to sample in the fall. Another benefit of fall testing is that fertilizer prices are more likely to be discounted then. Hayfields can be sampled after any cutting. Regardless of when you sample, it is best to be consistent from one year to the next.

Winter sampling, or sampling when the soil is frozen, is permissible only when it is possible to take a uniform boring or core of soil to the appropriate depth. This may require using a portable power boring tool. Using a pick or spade to remove a few chunks of frozen soil from the surface will give inaccurate results.

Where to take soil samples

If the field is generally uniform, fewer composite samples may be required than for fields with more variation. A composite sample consists of a core or boring taken from at least 10 different places in the area to be sampled.

Avoid sampling areas such as:

- dead furrows or back furrows
- lime, sludge, or manure piles
- animal droppings
- near fences or roads
- rows where fertilizer has been banded
- eroded knolls
- low spots

In general, do not sample any area of a field that varies widely from the rest of the field in color, fertility, slope, texture (sandy, clayey, etc.), drainage, or productivity. If the distinctive area is large enough to receive lime or fertilizer treatments different from the rest of the field, sample it separately. If manure or crop residues are on the surface, push aside these organic materials to keep from including them in the soil sample.

On contour strip fields, sample each strip separately if it is approximately 5 acres or more in size, following the sampling intensity guidelines listed in this publication. Cores from two or three small strips that have identical cropping and management histories may be combined following these same recommended sampling intensity guidelines.

Goals of a soil sampling program

When sampling soils for testing and obtaining fertilizer and lime recommendations, the most common objectives are to

1. obtain samples that accurately represent the field from which they were taken;
2. estimate the amount of nutrients that should be applied to provide the greatest economic return to the grower;
3. provide some estimate of the variation that exists within the field and how the nutrients are distributed spatially; and
4. monitor the changes in nutrient status of the field over time.

The ultimate goal of the fertility program needs to be considered before taking any samples, as that will determine how many are needed and where to sample. For example, if you intend to fertilize the entire field using a single application rate, you would need to collect fewer samples than if you plan to apply variable rates of fertilizer within the field. The second application strategy, known as site-specific management, requires special equipment to change rates of manure, lime, or fertilizer on the go. To select between the sampling strategies, consider analytical costs, field fertilization history, and the likelihood of response to variable fertilization. Each approach is outlined below.

Sampling fields for a single recommendation

With conventional sampling, you will receive a single set of results based on sample averages. The sampling guidelines in table 1 are based on when the field was last tested (more or less than 4 years) and whether the fields were responsive or non-responsive the last time they were tested (if within 4 years). The **responsive** range is considered to be where either soil test P or K levels are in the high (H) category or lower. A **non-responsive** field is one where both soil test P and K levels are in the very high (VH) or excessively high (EH) categories.

To assure accurate representation of the nutrient needs of the field, each sample should be made up of a minimum of 10 cores. Research has shown that taking 10–20 cores provides a more representative sample of the area than when samples are made up of fewer cores. Use a W-shaped sampling pattern (as shown in figure 1) when gathering composite samples. Be sure to thoroughly mix the cores before placing approximately 2 cups in the sample bag.

It is an advantage to submit multiple samples for all fields. When at least three samples are provided, the Wisconsin soil test recommendation program will remove samples that are significantly higher than the field average. This ensures that no part of the field is under-fertilized. Where only one or two samples are submitted for a field, no sample can be discarded, whereas one sample can be discarded if three or four samples are submitted, and up to two samples may be discarded from fields having five or more samples.

Sampling fields for site-specific management

Site-specific management requires a distinct picture of the magnitude and location of soil variability. Sampling soils for site-specific management usually involves taking many more composite samples than sampling for a single recommendation. The global positioning system (GPS) is used to record the geographical coordinates of each sample. This information is used to generate an application map with mathematically derived boundaries between soil test levels. Using variable rate application technology, these fields can be managed more intensively than the conventional approach of one fertilizer and lime rate per field.

When using a site-specific approach to soil sampling, sample handling and testing are similar to the traditional system, but recommendations may vary from one part of the field to another, and these areas must be managed separately to realize the potential advantages of intensive soil sampling.

Several sampling strategies can be used to guide variable-rate fertilizer and lime applications. **Grid sampling** uses a systematic approach that divides the field into squares of approximately equal size (grid cells). The sampling technique used is known as grid-point sampling. A grid-point sample consists of at least 10 cores collected from a small area (10-foot radius) around a geo-referenced point. When using a grid sampling approach, Wisconsin research recommends a sampling strategy based on an unaligned systematic grid (figure 2). Sampling points should be unaligned because sampling in a uniform grid arrangement may lead to biased results if aligned with row patterns. Fields that have soil test P and K levels in the non-responsive categories should be grid-point sampled on a 300-foot grid. Fields that in the past have tested in the responsive categories (interpretive levels of "high" or below) may need to be sampled on a grid no larger than 200 feet. A careful evaluation of the economics of this intensive of a sampling system needs to be done before proceeding.

Table 1.
Recommended sample intensity for "uniform" fields.

Field characteristics	Field size (acres)	Suggested sample number*
Fields tested more than 4 yrs ago and fields testing in the responsive range	all fields	1 sample/ 5 acres
Non-responsive fields tested within past 4 yrs	5–10	2
	11–25	3
	26–40	4
	41–60	5
	61–80	6
	81–100	7

**10 cores/sample minimum.*

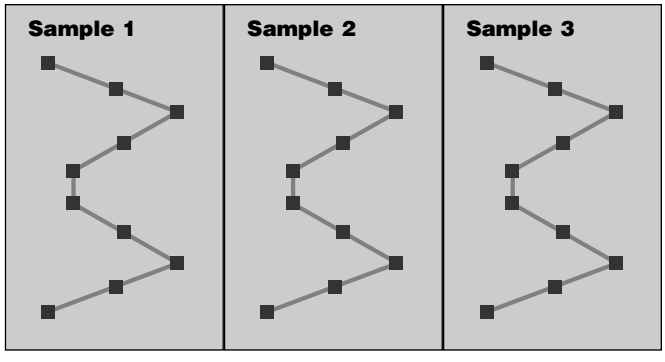


Figure 1. Recommended W-shaped sampling pattern for a 15-acre field. Each sample should be composed of at least 10 cores.

Another approach gaining support among researchers is the **management zone sampling method**, also known as directed or "smart" sampling. The basic concept of this approach is to use various layers of information that have been collected using other precision agricultural technologies such as yield maps, aerial photographs of bare soil or crop canopy, or soil electrical conductivity measurements. Directed sampling evaluates the spatial distribution of several factors that may influence nutrient availability in soil and crop productivity to help define sampling areas with similar characteristics. The grid-point method can be used in management zones with sample points clustered within the zone, rather than being uniformly dispersed in the field. If the results of grid or management zone sampling do not warrant variable-rate application (for example, relatively little between-sample variation), average them to determine the appropriate single-rate treatment.

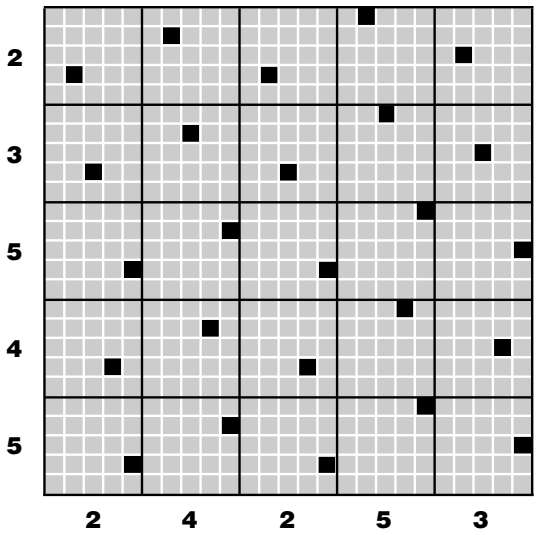
Regardless of the strategy used, soil must be collected from several locations within the defined sampling area. Fertilizer recommendations become increasingly accurate as the number of cores per sample and the number of samples increases. However, the value of that accuracy must be weighed against the economics of greater expense, and the practicality of taking more samples.

How to take soil samples

The following guidelines will help you take full advantage of the soil samples collected and the Wisconsin soil test recommendation program. If the soil sample is to be used in conjunction with cost-sharing programs requiring the use of a Wisconsin certified laboratory, or is being submitted as part of a nutrient management plan, these steps must be followed.

1. **Use a sampling probe or auger to take samples.** You can obtain these tools on loan from most county Extension offices, crop consultants or fertilizer dealers.
2. **Insert the probe or auger into the soil to plow depth or at least 6 inches.** To aid year-to-year comparisons, it is important to take repeated samplings from the same field to exactly the same depth.
3. **Take at least 10 soil cores or borings for each composite sample** and, preferably, at least two composite samples for every field. For non-responsive fields greater than 5 acres in size, obtain, at a minimum, the number of samples specified in table 1. For responsive fields that have not been sampled in the past 4 years, take one composite sample for every 5 acres.
4. **Place the sample (about 2 cups) in a soil sample bag.** Sample bags are available from all soil testing labs.
5. **Identify the bag with your name, field identification, and sample number.**
6. **Record the field and sample location** on an aerial photo or sketch of the farm and retain for your reference.
7. **Fill out the soil information sheet.** The more completely and carefully this sheet is filled out, the better the recommendation will be. Read the instructions on the back side of the sheet. Be sure to include the soil series name for each field. The soil series can be obtained from your Natural Resource Conservation Service (NRCS) farm plan or your country NRCS office.

Figure 2. An example of an unaligned grid pattern for sampling site-specific fields.



What to do with soil samples

The soil samples and a completed soil information sheet can be taken to your county Extension office for forwarding to an approved soil testing laboratory. If this is not convenient, soil samples can be sent directly to the soil testing laboratory or delivered in person. Place the soil information sheet in a separate first-class envelope and attach it to the soil sample container. The soil test report containing test results and lime and fertilizer recommendations are normally returned within 2 weeks.

The University of Wisconsin-Madison, through the Department of Soil Science, operates soil testing laboratories at Madison and Marshfield. You may also use private soil testing laboratories,

some of which are approved for cost-sharing purposes. Your county Extension office can provide you with addresses of Wisconsin Certified Labs, or you can obtain a current list at the UW Soil and Plant Analysis Laboratory web site (http://uwlab.soils.wisc.edu). Fee schedules for the various soil tests at the University of Wisconsin soil testing labs are available from these labs. To have your soils tested at the university laboratories send samples to either:

Soil and Plant Analysis Laboratory
5711 Mineral Point Road
Madison, WI 53705-4453
(608) 262-4364

or

Soil and Forage Analysis Laboratory
8396 Yellowstone Drive
Marshfield, WI 54449-8401
(715) 387-2523

How often to sample

For field crops, sampling the soil once every 3–4 years or once in a rotation is sufficient. Fields that are more susceptible to changes in nutrient levels, such as those with sandy soils, or those used to raise high-value crops such as potatoes should be sampled more frequently.

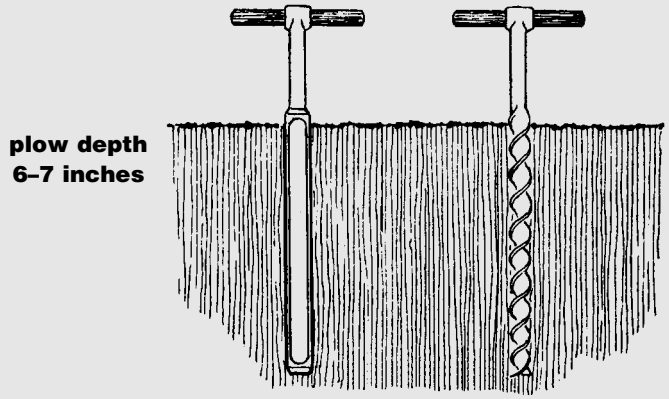
Tillage system considerations when sampling

Moldboard plowing. Sample to the depth of tillage.

Chisel plowing and offset disking. Take soil samples to ¾ of the tillage depth. When possible, take soil samples before spring or fall tillage. Sampling before tillage lets you determine the sampling depth more accurately and you can avoid fertilizer bands applied for the previous crop.

Till-plant and ridge tillage. Sample ridges to the 6-inch depth and furrows (between rows) to a depth of 4 inches. Combine equal numbers of soil cores from ridges and furrows to make up the composite sample.

No-till. Fields that have not been tilled for 5 years or more may develop an acid layer on the surface from the use of nitrogen fertilizer. This acid layer could reduce the effectiveness of triazine herbicides. Unincorporated phosphorus (P) and potassium (K) are also likely to build up in the surface soil. If an acid layer is suspected, take a separate sample to a depth of only 2 inches. When sending the soil to the lab, indicate that the sampling depth was only 2 inches. This sample will be tested for pH only, unless P and K are specifically requested. For fertilizer recommendations, take a separate sample to a depth of 6–7 inches. Fertilizer recommendations require this sampling depth because fertilizer calibration studies are based on plow-depth sampling. Sample between rows to avoid fertilizer bands.



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